tied together by iron ties, and abutted in the centre on an iron beam. The spaces between the upper surface of the arches and the spandrils were filled in by mortar, on which flat tiles were imbedded. They answered the purpose perfectly; but the weight of a floor of such a construction must be very great. Observing this construction, and, generally, the economy of constructions of groined arches in brick, where the same centreing was used successively for many arches, it occurred to me to propose the construction of such floors of hollow brick, moulded in form for the purpose. The precise thickness, and the best forms of bricks for the purpose, may not be readily determined. The expense of an ordinary wooden floor, of 12 feet square, would be about, I am informed, 7*l.*; the expense of an arched floor of the hollow brick construction, tied together with iron ties, taking the hollow brick at one-third less price than the solid bricks, is estimated at 4*l.*

With constructions of these hollow bricks experiments were made—

1st. For a series of arches of small curvatures without iron ties.

2nd. For circular arches without iron ties.

3rd. Elliptical arches with iron ties. The experimental arches were 2 metres, or 6 feet 6 inches wide, or 43 square feet, being a portion of a surface of 600 feet.

The ordinary weight of a common wooden floor of that extent, as constructed in England, would be about 700 lbs., and it would be expected to bear say 2 tons. Each ton would be equivalent to the average weight of say fifteen adult persons, at least, in England. The results were—That the elliptical arch made of earthenware pots or hollow bricks, 6¼ inches high and 3½ inches in diameter, without iron ties, supported, besides its own weight, a load of about 2 tons 10 cwt. on each 10 superficial feet.

That an arch of small curvature, made of hollow bricks 9¼ inches high and 5½ inches diameter, supported besides its own weight a load of 3 tons 18 cwt. on 10¼ superficial feet.

That a portion of a circular arch, constructed with earthenware pots 12½ inches deep and 5½ inches in diameter, supported besides its own weight a load of upwards of 5 tons, or the weight of more than 67 adult persons of 165 lbs. each; that a floor of earthen pots, 4 inches high and 3½ inches in diameter, tied with iron ties, supported besides its own weight a load of 2 tons per square foot; that a floor, formed with earthen pots 7¼ inches high and 4½ inches in diameter, and tied with iron ties, supported more than 3,994 lbs., or the weight of 24 adult persons, besides its own weight.

The experiments and practical experience in private and public buildings of the Parisian architect corroborate the general conclusions which are submitted as established in relation to the hollow brick construction, as being superior to the common stone and brick construction:—

In preventing the passage of humidity and being drier.

In preventing the passage of heat, and being warmer in winter and cooler in summer.

In being a security against fire.

In preventing the passage of sound.

In having less unnecessary material and being lighter.

In being better dried and burnt harder and stronger.

In being more cleanly.

In being cheaper.

The extent to which these qualities are attainable must depend upon the extent of demand for them, upon further attention and experience been brought to bear upon them, and on the approved application of machinery to the construction of the various eligible forms of hollow bricks.

So far Mr. Chadwick.

The modern French architects use a kind of pottery vase in construction for partition walls, floors, stairs, and ceilings; but they depend more upon the lightness of the material and the strength of their mortar and cement, for the stability of their works, than upon skill in constructive adaptation of their hollow pots. If fact, the stability of their work depends upon the strength of the mortar or cement (gypsum), and iron bond, altogether, as a glance at their forms of hollow ware will show. We are not without some modern examples of hollow brick or tile work even in London—floors and arches have been found of such material, as when the old Carlton Palace was taken down, as mentioned in the manuscript volume already referred to. It is difficult in this our day, to settle satisfactorily where or how an idea is obtained. "Necessity is said to be the mother of invention," and no doubt many inventions are new to the person, which are old to the world; the faculties of the mind are infinite for purposes of combination in thought, but frequently similar in their results. Two men, wide apart, in distant regions, may strike at the same idea, when investigating the same causes; and, we, consequently, have every great invention disputed by rival claimants. It was so with Franklin and electricity; and one of the most recent instances is the discovery of the planet Neptune, in astronomy. If, however, all men were honest to themselves, they would care little about priority of discovery, as the man who is anxious to earn fame from one lucky thought or invention, is seldom deserving of the honour. True genius will not rob for an idea, and has no fear of robbery from others; but it will adapt, mould, and use the ideas of every age, for purposes of utility, ornament, and truth.

The ceiling now turned over St. George's Hall, Liverpool, was designed by my late friend, Mr. Elmes, a bill of quantities for which was made out by him in March, 1843. The arch was to be of solid brickwork. Patent compressed bricks were specified for, and for this mode of construction the contract was let to Mr. Tomkinson, the builder. I had many conversations with Mr. Elmes from time to time about the arch, and I always expressed myself confidently as to its practicability. Several forms of section were made, and Mr. Elmes sought up all the known examples of great ceilings to guide him in the construction of his own. The form and sectional strength settled, another difficulty presented itself. The room must be ventilated according to plans devised by Dr. Reid, and the doctor required 400 square feet of open space, as equally diffused throughout the arch as possible.*

When the time for preparation to commence the work came, Mr. Elmes was stricken with his fatal malady; his strength was failing, and the physicians had ordered him abroad: he sent for me to come and see him, and as I was not at the time much engaged, I commenced some sections of the arch to provide for the required space for ventilation; and the plan decided upon at the time was, to leave out alternate headers, as frequently seen in the sides of a barn.

I had quite forgotten seeing hollow bricks in Mr. Chadwick's office at Somerset-house, although I had written to Mr. Elmes at the time recommending their use. But it was certainly with Mr. Chadwick that I first saw them. These were of the ordinary size.

Mr. Elmes left England never to return, and as the time for commencing the arch drew on, I was constantly turning the subject over in my mind how I could obtain lightness, open space, and strength. About this time I was called over to Castle Howard on professional business; and, in the steward's office I saw some beautiful drain-tiles, 12 inches long, with a bore of 2 inches in diameter. I took one up, examined it, and asked how and where it was made, when I learned that they had machines which made them on their own estate. My first idea was, why not construct an arch of circular tile, set in cement? My next question was, will the machine make other shapes than the circle? and the answer was, "any shape you like." I then thought of hexagons, and finally adopted the square, and settled the present dimensions, four inches by four inches, by twelve and a half inches, for purposes of bond. On my return to Liverpool, I wrote to Mr. Scragg, the maker of the machines, and asked him to meet me on the ground at St. George's Hall. I shewed him the sections, and the building, explained what I required him to make, and ordered fifty tiles to be made of the dimensions above stated; half with a longitudinal perforation of three inches, and half two inches. I then weighted them singly, and decided upon the two-inch perforation. I drew up a report,* and presented it to the committee, when they decided at once to adopt the hollow tile. I consulted Dr. Reid about them, and had his full concurrence for their use. I loaded four of the tiles, placed singly, with upwards of thirteen tons, without their shewing any tendency to fracture, and I left them loaded as an answer to all objections to their use on the score of strength (and there were many), intending to have loaded them to crushing, but they were removed without my knowledge. For equal drying, I had fifty thousand moulded with square perforations, but the maker said he found little or no advantage over the circle. Not only was the great hall ceiling intended to be of brick, but the ceiling over the two courts, which are about fifty feet square. These, however, have been formed of timber, notwithstanding the order of the committee to the contrary, and although the hollow bricks for their construction were delivered on the ground.

The great arch is struck from three centres, and the soffit is divided into panels, the ribs to form which are worked in the tile. These longitudinal ribs are bonded with York paving, four inches in thickness, cramped together at the joints. The main ribs of the arch are two tiles, or two feet in depth; the plain portions of the panels are twelve inches, or one tile in depth, so that the strength of the arch, of sixty-five feet span, is reduced to twelve inches in depth, with the weight of the panel ribs added. The accompanying section † will further explain the construction.

That hollow bricks may be used in arches, with perfect safety to the structure, is, I think, fully proved, and I have no doubt but that the researches of Mr. Chadwick will soon be brought into practical use. The machines are an advantage unknown to the ancients, and we may obtain from them a truth of form which shall not depend upon the strength of the cement alone for the stability of the structure. It was the custom formerly to score, or reed, the surface of all pulleys to make the driving strap adhere. This not only lost power, but it rapidly wore out strap and pulley; so we shall find in another way, with our brick and tile work: mould the correct forms, put them together in a proper manner, and we shall require mortar to bed them, but not to be also the sole means of stability and support.

In these modern times we are too much wedded to "precedent," without always fully considering if it is worth imitation, and we are apt to make "ornament" the first consideration, when, in all cases, it ought to be construction. Nature, in this, should be followed. The skeleton of the building ought to be perfect; then clothe and beautify in accordance with that skeleton structure. Nature is ever beautiful because most perfect; but the beauty of nature is not always for the sight. The external forms of grace alone, are present to the eye, but that which is hidden is frequently more complex, wonderful, and beautiful than that we see. Take the skeleton of any animal, and what a combination of structural beauty does it unfold; joint fitted to joint, bone adapted to bone, solidity where solidity is required, tubular where advantageous; notice the graceful curves, the swelling joints, the arched spines, the flattened blades, the serrated skull, and answer if the build of any creature could be improved by all the ingenuity of the skilled mechanic, or the calculations of the most profound mathematician. Take the graceful nautilus, examine its plated chambers,

* Elmes was seriously perplexed by the requirements insisted on for ventilation. As to some alterations in the external appearance of the building in consequence, a correspondent from Liverpool wrote thus last week:—"I was surprised to observe that, in a recent notice of Elmes's magnificent pile, the St. George's Hall here, you had not remarked that the 'sky line' of the admirably designed central mass was broken and destroyed by the projection of a huge louvred structure, rising above the intended ridge of the main roof, and that the circular termination to the north, containing the concert-room, is shockingly disfigured by a polygonal boarded lantern, which has been aptly compared to the ventilator of a common brewery. Both these blots are the result of the adoption of the method of ventilating, and were never contemplated by the architect in the first instance, as may be seen by examining the model kept on the works; and though I believe every exertion was made by that lamented artist to save his beautiful design from such injury, he strove in vain; the inexorable doctor would not give way, nor would the corporation authorise a departure from his project. An additional couple of courses in the stonework of the centre would have hidden the eyesore *there*, though certainly at some sacrifice of its deeply-studied proportions, but cure for the northern excrescence there was none, but by making it, if possible, a sightly, since it would never be an ornamental, adjunct. Neither of these remedies has been applied, the economy imposed upon the building committee by the accession of several heavy items beyond the contemplated cost of the building, preventing the further addition which would have been thus incurred. It is needless to say that to a man of Elmes's fine taste such unsightly projections on his intended outline were a source of great annoyance, or that they will have a like effect on every one with a feeling for the beautiful in architecture; but that they are indispensable to the proper ventilation of the buildings, or that the same area of exit could not have been provided in some less obtrusive manner, would, I venture to think, be less easy of proof."—Ed.

* This we will give, with the specification, next week.—Ed.

† The section is to a scale of 1-16th of an inch to 1 foot. We likewise give a plan of the great hall and adjoining apartments, which serve as abutments. (see page 196). The spaces marked A A on plan are for ventilation.—Ed.

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